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DESCRIPTION OF TWO TUMOURS

ADHERENT TO THE

DEEP SURFACE OF THE DURA-MATER.

BY

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The interest of the two tumours about to be described depends partly on their nature and situation, as nonvascular tumours developed entirely from the serous surface of the dura-mater, partly on their microscopic structure, and, it may be added, partly on their relation to Pacchionian corpuscles, structures the constancy of whose occurrence, together with their functional unimportance, and the limited extent of area in which they are found, has made them a puzzle to anatomists.

Case I.—On removal of the brain from a subject in the anatomical rooms in the university, there was discovered a limited roundish tumour of firm consistency, about two inches long from before backwards, one and a half high, and one and three quarters broad, growing up from the middle line of the anterior fossa of the skull. It pressed more upon the left than the right hemisphere of the brain, so that although there was softening of the internal inferior portion of the right anterior lobe, the arachnoid and pia-mater covering that part were intact, while a considerable portion of the grey substance of the left anterior lobe had entirely disappeared by absorption, and the membranes corresponding to it were represented only by some shreds adherent to the surface of the tumour.

The body was that of a female, who, according to the medical certificate was fifty years old, and had died of bronchitis.

Dr. Robertson, the medical officer of the city poorhouse, on being communicated with, kindly furnished the following particulars of the case:—"The deceased was an epileptic, and had been so for many years; the exact number I cannot ascertain. She generally had two or three fits within 24 hours, after which she had commonly an interval of ten days or a fortnight before their return in the same way. The convulsions were very severe and general, and frequently she bit the tongue. There was no aura. She was occasionally a little violent in her conduct prior to and after the fits. Her mental faculties, even in the intervals, were impaired, though not very markedly, and she could give intelligent replies to simple questions, even more so than many epileptics whom I have under my care. There was no paralysis, and general and special sensation were normal so far as I know; but I did not examine their condition minutely."

The tumour was seen upon more careful examination to be closely adherent to the crista-galli and cribriform plate of the ethmoid. It was deeply cleft in front by the falx cerebri, which however was quite free from it, nearly to its base. Near its base it was attached to the dura-mater by delicate tissue, quite distinct from the proper texture of that membrane, and which was easily divided with a needle. In this way it could be detached from the dura-mater as far as the orifices of the larger perforations in the mesial border of the cribriform plate, with the processes of dura-mater lining which it appeared to be closely connected. By its bulk it had pressed not only on the brain, but to a slight extent on the left orbital wing of the sphenoid; for that process, though quite unconnected with the morbid growth, being separated from it by dura-mater, was curved and thickened, in a manner similar to that in which a soft substance would be crushed aside by a hard body pressed against it; the deformity, however, being slight.

In consistence the tumour was firm and equal, but it offered very little resistance to the knife, and could easily be penetrated by a blunt pointed instrument. In fact, it resembled pretty nearly a boiled parenchymatous structure, both in consistence and in the ease with which small portions were detached with the forceps, on account of the slight tenacity of its fibre. The surface was nodulated, and partly smooth, partly papillary and villous. The smooth parts had a distinctly separable fine membrane on the surface, which at the sides of the patches was lost in the substance of the villous portions around. The villosities when pressed asunder easily allowed deep cracks to open between them. On the aspect next the forehead was a separate layer of substance, similar to the main mass of the tumour, but only connected with it and with the dura-mater at its base by slender areolar tissue. At no part were there any tenacious fibres derived from the dura-mater and running into the tumour.

When a transverse vertical section had been made, the cut surface exhibited a uniform appearance similar in colour to the grey matter of the brain. The centre of the section passed through a small irregular plate of bone about a couple of lines deep and twice as long, placed vertically in the mesial line, about half an inch above the crista galli, and slightly connected with the falx in front. It presented the lacunæ and canaliculi of true bone, and was exactly similar to the ossifications frequently met with in the edge of the falx (fig. 2).

Small portions of the tumour, prepared for microscopic inspection, when slightly rubbed against the glass cover, allowed a large quantity of granular matter to separate from them, rendering opaque the fluid in which they were. A large bulk of the tumour consisted of such matter, which was composed in great part, if not entirely, of nucleated cells, of which numbers were seen about 1-3000th of an inch in diameter (fig. 1). Mingled with these were epithelioid cells of considerable size, and oil globules. The stroma was of fine connective tissue, which, close to the surface where it formed the membrane already mentioned, had the ordinary arrangement of distinct, linear, undulating fibres, but in the rest of the tumour presented principally the appearance of long and broad fibres, with sometimes an obscure longitudinal striation, tapering to their extremities and ending usually in single points. But the most remarkable elements of the tumour were of a concretionary character, partly based on the cellular, partly on the fibrous element. The cellular concretions were round structures, strongly refracting light, and capable of being cracked by pressure of the glass cover. The largest of them were about 1-200th of an inch in diameter, and much resembled the corpora amylacea found in brain-substance, or spherical prostatic concretions. But while prostatic concretions are to be found of very small size, refracting light as strongly as those which are larger, in this instance the smaller concretions were not so dense, and showed their laminated structure more distinctly. Of somewhat less diameter, there were laminated bodies without any hard matter deposited in them, and they, by specimens of smaller size, graduated into the minute cells already mentioned. These concretions were not visibly affected by acetic acid, but mineral acid slowly dissolved part of the substance to which they owed their density, and without altering their size made them soft, and exhibited their laminated structure, which extended nearly to their centres. Treatment with mineral acid and caustic potash applied alternately softened them most speedily. Glycerine likewise brought their lamination into view, together with one or several small irregular dark masses in the hearts of many, which disappeared from those which were treated with mineral acid.

The concretions referred to as based upon the fibrous element were deposited within the broad fibres of the connective tissue. They were of irregular elongated forms with swellings and contractions, having a nodulated appearance, often swollen into a large nodule at one end, and presenting frequently small branches. Beyond their extremities one could often see the continuations of the fibres in which they were developed. They were obviously of the same composition as the round concretions, with the exception that they contained a greater amount of mineral matter, so that they were acted on sooner by acids, and, not being laminated, could scarcely be distinguished afterwards from the surrounding connective tissue, in which no deposition had taken place. A small amount of gas liberated slowly on the addition of muriatic acid indicated a mere trace of carbonates.

Neither set of concretions gave either blue or deep brown colour when treated with iodine and sulphuric acid. In this respect they were not different from many prostatic corpuscles, a number of which are not specially affected by iodine, though others are rendered blue or deep brown.* They quite corresponded to the bodies sometimes found in Pacchionian corpuscles, of which Luschka writing says :—" I found them also in the rest of the arachnoid repeatedly, both in man and other animals. These structures seem to me to be concentrically laminated fibrinous concretions with nuclei of consistent fat." As has been already said, however, the nuclei in the present case disappeared by the action of acids, and therefore they were not fatty. The elongated concretions, in being more completely mineral in composition, were more nearly allied to the brain sand or acervulus cerebri, which they also resembled in their nodulated appearance. Leidig indeed writes of the brain sand that it often appears as an incrustation of connective tissue,† and to such a variety the resemblance will be very exact.

It is further to be observed that the tumour was entirely nonvascular, and that the concretions were most fully developed towards its centre, while at the surface they were absent, and for a little way inwards they were small and inconspicuous. The cells also had more delicate walls near the surface than towards the centre. Whence it appears that the tumour had increased by additions to its periphery; and, considering its nonvascular structure, it probably drew its nourishment from the fluids in the tissues with which its surface was in contact. The history of the case makes it probable the tumour was of slow growth.

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* Virchow's Cellular Pathology, translation by Dr. Chance, p. 371.

† Leidig, Lehrbuch der Histologie, p. 170.

Besides the main tumour, there was also another of similar appearance, about the size and shape of a hazel-nut kernel, in connection with the free border of the falx, about the middle of its extent. Its structure, likewise, presented numerous concretions, which were principally remarkable in exhibiting the passage from the spherical to the irregular elongated forms. Some were large and oval, one of them proving on measurement to be 1-100th of an inch long and 1-400th broad, exclusive of the laminated stroma in which it was imbedded; while others of similar shape were more irregular at the extremities, and in a stroma fibrously arranged.

Case II.—For the opportunity of examining the tumour about to be described, the writer is indebted to Dr. Samuel Moore, the indefatigable conductor of the pathological department in the Royal Infirmary.

The tumour was adherent to the inner aspect of the dura mater, of a hemispherical form, an inch and a half in diameter at its base, and projecting nearly an inch into the cranial cavity. It was situated in the upper part of the frontal region, on the right side, with its internal margin almost abutting against the superior longitudinal sinus. Dr. Moore has furnished the following particulars:—"The man at whose autopsy the tumour was obtained was 56 years of age. He had fallen down while at work, and been brought to the Infirmary in a comatose condition, from which he had never completely recovered; and had died 28 hours after admission. On reflexion of the dura-mater the tumour was exposed. It had formed a cup-shaped depression for itself on the anterior and superior surface of the right hemisphere of the cerebrum, almost close to the longitudinal fissure. The substance of the brain on which the tumour pressed was subjected to a careful microscopic examination, and seemed to be quite normal in texture. In the left ventricle, and on the base of the brain, there was a large quantity of extravasated blood. There was slight fatty degeneration of the heart, and some atheromatous patches on the arch and thoracic portion of the aorta. Some small patches were also observed on the arteries of the brain. I have no doubt that this condition of the vessels was the cause of the apoplexy which produced death. I learned from the relations of the deceased, that he had been subject to attacks of epilepsy for several years previous to his death, and that he had always fallen on one side, but they were not certain on which."

The surface of the tumour presented a uniform curvature, and was papillary on its most prominent part, the papillæ being similar in appearance to enlarged Pacchionian corpuscles; but near the base it was less broken up, and in some parts smooth and glistening (fig. 3). The base was slightly extended beyond the rest of the tumour, so that the whole had exactly the form of a contracted sea anemone. On section it presented a delicate fibrous appearance without trace of vascularity, of uniform texture similar to the former tumour, but not so firm. Examined microscopically, it proved to be of a highly cellular structure (fig. 4). There was a very delicate homogeneous matrix of connective tissue, in many places having the appearance of shreds of very fine membrane, while imbedded in it were numerous elliptical nuclei with granular contents. In other places the connective tissue exhibited long and slender, sometimes branched, fibres, or was split up into short fusiform fibres, in the middle of which one could see a nucleus of the description just mentioned. Nuclei of the same sort also occurred, surrounded by a large cell-wall, and two or three were sometimes seen scattered within a larger cell. Masses of the tumour seemed entirely made up of clumps of cells gathered into a ball, and surrounded by an irregular layer of substance not sufficiently definite in outline for the continuous membrane of a cell-wall, but rather looking like laminæ deposited round about them. These clumps corresponded very much in appearance with the brood-cavities or mother cells of authors; but the view of them just expressed is supported by the tendency to lamination exhibited by the stroma of this tumour. A great number of laminated bodies were seen, in some instances isolated, and in others in clusters. In some cases one or two of the small cells mentioned formed the centre of a laminated body; more frequently the centre was occupied by a solid body of larger size and irregular outline, with occasionally some of those cells adherent to it. But the laminated bodies, in the great majority of cases, had an appearance of density similar to the surrounding tissue, looking, in fact, like the hard concretions of the previous tumour after they had been softened by reagents. There were, however, a few hard concretions.

On examination of the substance obtained by scraping the cut surface, there were seen, besides the constituents mentioned, and oil globules, a great number of bodies circular, oval, and irregular in form, of a variety of sizes, from about 1-2000th of an inch, and upwards, down to minute granules. They floated loosely about, and those which were most regular in form looked, when at rest, not unlike oil globules; but on being set in motion they were seen to be flattened like epithelial cells. Some had a distinct double contour, others had only a small cavity in the middle, while others were solid, and in some instances contained a small clear drop, as of a fluid different from their other contents. Some of them sent off small rounded processes, and one or two were seen clustered round with flask-like buds. Apparently they contained cholesterine. This idea is supported by their lightness, by the presence of crystals of cholesterine in the tumour, and by their similarity in appearance to that substance. In one or two instances the centre of a concretion obviously consisted of one of those bodies. They have very likely originated at first as an altered form of the nuclei so abundant, and thus may be formations similar to those vesicles described and figured by Mr. Paget, as occurring in cells of epithelial cancers,* and also described by Virchow, under the name of physalides.† Portions of this tumour treated with iodine and sulphuric acid gave only a few stray patches of blue colour. The dura-mater to which the tumour was adherent was unaltered in thickness or appearance.

Remarks.—Tumours growing from the cerebral aspect of the dura-mater are not uncommon. Rokitansky, under the head of cancer of the arachnoid, writes:—"Adventitious growths which belong to the present section, frequently occur on the inner surface of the dura-mater. We meet with delicate villous, vascular, fungous growths, with thoroughly encephaloid formation, with tumours minutely divided into acini like some glands, with lobulated masses variously streaked with fibres, and so forth."‡ Wedl, with the same inclination to class together as malignant tumours all the growths from the cerebral surface of the dura-mater, writes:—"Those delicate villous growths, seen on the inner surface of the arachnoid, are to be regarded decidedly as of a cancerous nature."§ Cruveilhier‖ describes a number of tumours in this situation, all of which he considers more or less malignant. Some of them agree in position very exactly with the second now described, being situated beneath the calvarium, not far from the falx, and projecting inwards without any tendency to interfere with the dura-mater at their base; but they are of a dense character and highly vascular. One case represented by Cruveilhier, is a tumour fixed to the cribriform plate, and in situation, size, general appearance, and radiated direction of the fibres, corresponds very closely to the first case now described; but, on the other hand, it was vascular, firm, and sent small lobes down in to the cavity of the nose. Lebert¶ describes two tumours, one growing from the cribriform plate, the other from the calvarium, which correspond very nearly to those now described; and from one of them he figures "mother-cells" exactly similar to those in the second case before us. He places them in his group of fibro-plastic tumours, the myeloid tumours of Paget, and states that they were vascular. Another tumour, very similar to the first of the cases under consideration, is described by Dr. C. E. E. Hoffman.* It arose from the base of the Sella Turcica, and consisted entirely of spindle-shaped nucleated fibre cells. In none of the cases referred to, however, is there the absence of vascularity, or the presence of the hard concretions, which characterize the cases before us. Much closer is the resemblance of Case I. to a tumour described by Dr. Bennett;† which was attached to the under surface of the tentorium, and "was the size of a small walnut, surrounded by a distinct cyst, and when cut into, the substance presented a soft, granular, and slightly fibrous consistence, and pale yellow colour." This tumour was characterized by the presence in very great quantity of spherical concretions, which Dr. Bennett has figured, and which correspond exactly with those above described. In another tumour from the tentorium, Dr. Bennett found "globules with double lines," which appear, from his figure of them, to have had considerable resemblance in some respects to the bodies found in Case II.‡

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* Paget, Surgical Pathology, vol. ii., p. 438.

† Virchow, Cellular Pathology, translation, p. 401.

‡ Rokitansky, Pathological Anatomy, Trans. Syd. Soc. vol. iii., p. 336.

§ Wedl, Pathological Histology, Trans. Syd. Soc. p. 565.

‖ Cruveilhier, Anatomie Pathologique, liv. viii., plates I. II. III.

¶ Lebert, Traite d'Anat. Path. vol. i. p. 204, plate XXVII. f. 4 and 5, plat XXVIII. also f. 2.; vol. ii. p. 125, plate 101, f. 6–10.

Both the tumours which have been described have claims to be considered rather as epitheliomata than as fibro-plastic tumours, but neither of them was truly malignant. In neither case was there any tumour elsewhere, or any malignant affection in the body, and in neither was there any tendency of the neighbouring parts to become involved in the morbid growth. Neither had attained to vascularity, and in both there was the tendency to deposition of inert matter in the parts removed from the growing surface. Their relationship to Pacchionian corpuscles is very considerable, and will be brought out by an examination of the latter.

The nature of Pacchionian corpuscles has been most thoroughly investigated by Professor Luschka.§ That anatomist has shown that they are only an enlarged condition of normal villi of the arachnoid, and that no other structure is involved in their formation. The most prolific source of Pacchionian bodies is, as one may very soon discover, the cerebral or generally acknowledged layer of the arachnoid. They have no connection with the pia mater; and the villi, of which they are enlarged instances, exist constantly. Others arise in a similar manner from the opposing serous surface of the dura-mater or parietal layer of the arachnoid. They are described by Luschka thus:—

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* Virchow's Archiv. vol. xxv. p. 551, plate VI.

† Bennett on Cancerous and Cancroid Growths, p. 75.

‡ Loc. Cit. p. 73.

§ Luschka, über das Wesen der Pacchionishen Drüsen. Müller's Archiv. 1852, p. 101, plate IV. The statements there made are repeated in the work entitled Die Adergeflechte des menschlichen Gehirns, 1855; which, however, I have not seen.

"The fibrous bundles of the dura-mater near the upper border of the falx are arranged in a peculiar trabecular manner. Bundles stretching long distances stand out quite isolated from the level of the rest of the texture. Others form a complete network with numberless larger and smaller meshes. In many places the tissue is so disposed that large spaces and canals lie between the layers of fibres, and extend so far as to open in many places on the outer surface of the lining membrane of the sinus. Here it is that the parietal arachnoid exhibits a peculiar form. While this membrane is elsewhere smooth, and so firmly united with the dura-mater, that some have been unable to separate it, and have questioned its existence, it here becomes apparent in a peculiar form. It forms, where it covers the free projecting fibrous bundles, and where it dips into the hollows of the network, free papillary prolongations. These grow, on the one hand, into the space between the fibres round the sinus, till they reach its lining membrane and, carrying that before them, project into its cavity, or developing towards the skull, press the fibres of the dura-mater asunder, and gradually bore depressions in the bone. They also project out of the meshes against the brain, and hang freely down from individual fibrous bundles."

Dr. Ludwig Meyer, in a very lengthened paper "On the Nature of the Pacchionian Granulations,"* has declared very strongly against the presence of a parietal arachnoid, as well as of Pacchionian corpuscles originating from the serous aspect of the dura-mater. As regards the parietal arachnoid, the existence of such a membrane is very generally denied; as, however, the epethelial surface is admitted by all, the question as to whether an extremely thin inseparable layer of connective tissue exists between the epithelium and the fibrous dura-mater does not seem to be much more than a dispute of words. But the existence of parietal Pacchionian corpuscles I can distinctly confirm. A great number of the Pacchionian corpuscles which pierce the dura-mater certainly arise from the cerebral arachnoid, but numbers are also found arising in the manner described by Luschka in the passage quoted. That being the case, we are quite entitled to take even large Pacchionian corpuscles springing from the dura-mater as specimens of a separable serous membrane. Close to the anterior extremity of the falx small patches are to be seen corresponding in colour to cerebral arachnoid, and not to the dura-mater; and when examined by the microscope they are similar to the cerebral arachnoid in appearance.

As regards the minute structure of Pacchionian corpuscles, it consists of connective tissue arranged in broad homogeneous bands, which resemble those of the first tumour described, but are much branched and netted like the similar bands in the arachnoid. The occasional presence of hard concretions has been already alluded to. Dr. Ludwig Meyer observes that they are covered with a highly hypertrophied epithelium. They are composed not only of primary villi, but of secondary and tertiary series of smaller villi placed on the larger. In the secondary villi, Wedl has observed "fusiform cells with a well defined, oval, eccentric nucleus."

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* Virchow's Archiv. vol. xix. p. 171 and 288.

Luschka's explanation of the nature of these bodies still leaves unanswered the question why they appear so constantly in the neighbourhood of the superior longitudinal sinus. Meyer considers them the results of friction, and strives elaborately to prove that friction must arise from the changing bulk of the brain, according as the blood in the cranium is accumulated in the brain, or in the great veins and sinuses. The idea is scarcely a conceivable one. Possibly the peculiar conditions of the circulation in the neighbourhood may afford some explanation. The cerebral veins being directed forwards before entering the sinus, and the current in the sinus being directed backwards, the greater the tendency to a rush of blood from the sinus, the greater will be the resistance offered to the entrance of more blood from the veins. Thus a mechanism comes into play in aid of equability of the intracranial circulation, which in its action may be supposed to cause a frequent check upon the flow of the blood from the mouths of the veins; and a habitual engorgement or slowness of circulation in the extremities of the veins may be sufficient explanation of redundant growth of villi in their neighbourhood.

It appears, from what has been said, that the two tumours under consideration resemble the Pacchionian corpuscles in a number of points. Both are villous growths of the arachnoid; both are nonvascular; both have connective tissue in broad homogeneous bands; both have a copious cellular and nuclear element, both present hard concretions.

There is one difference worthy of remark; that while the tumours did not penetrate the dura-mater at all, the Pacchionian corpuscles not only penetrate it but absorb the bone before them. Luschka, it has been seen, explains the outward tendency of the Pacchionian corpuscles by the peculiar structure of the dura-mater near the longitudinal sinus.

As bearing upon the connection between these tumours and Pacchionian corpuscles, and on the nature of the latter, it is interesting to note the structure of the central parts of the intervertebral discs. Luschka has, in a work more recent than his inquiries into the Pacchionian corpuscles, shown that the central part of each disc is a synovial sac, the membrane of which is developed into grapelike processes, which fill up the cavity.* If we compare one of these processes with a Pacchionian corpuscle, we observe that both are grape-like bodies with smooth surfaces, the one growing from a synovial, the other from a serous membrane. The stroma of the intervertebral structure is much more delicate than that of the Pacchionian corpuscle, and its cellular element is more developed, like that of cartilage. But a very considerable tendency exists in it to the formation of laminated bodies, and a certain number of hardened concretions are to be found in it, quite similar to those found occasionally in Pacchionian corpuscles, and in such great abundance, as has been seen, in the tumours which have been described. Luschka has also figured in it mother-cells and masses of cells gathered into clumps.

It has been seen that both the large and the small tumours of the case first described were connected with the falx, a part of the dura-mater on which Pacchionian corpuscles are not developed. But the falx is exactly that part which is most liable to osseous deposits; and a piece of bone exactly similar to those which grow in connection with the falx, occurred in the heart of the large tumour. Those osseous growths of the falx appear, like the Pacchionian corpuscles, to be of arachnoidal origin. The fibres of the dura-mater are not found emerging from them or firmly united to them, so as to blend together the bone and fibrous membrane, as happens when bone is developed in other fibrous tissues. In this instance the osseous growths are but feebly connected with neighbouring parts. They lie often for a considerable part of their extent loosely against one side of the falx, while in other parts they occupy perforations of the falx, or descend below its border. The view that they are developments of the arachnoid is that taken by Rokitansky.† Probably the bone which occupied the centre of the large tumour had been developed first, and had afterwards become imbedded in a villous tumour, caused possibly by the irritation which it had produced. Otherwise, it is unlikely that a plate of bone in the centre of a round tumour with radiating fibres should have been developed in a direction nearly corresponding with the mesial plane, and have had exactly the appearance of the common ossifications of the falx.

EXPLANATION OF PLATES.

I. Microscopic elements of the tumours of Case I.; viz., small nucleated cells; broad bands of connective tissue; hard spherical concretions, one of them fractured, one exhibiting its lamination, two of them with dark granular centres;

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* Luschka, Die Halbgelenke, 1858, p. 46, and plate III. fig. 8.

† Loc. Cit. vol. iii., p. 335.

irregular elongated concretions developed in the connective tissue, and laminated bodies of small size, in which there has been no mineral deposition. × 350.

II. Section of the principal tumour of Case I. Below is the section of the crista galli, and at each side the dura-mater; above, the surface of the tumour is seen in perspective; to the right side is the loose portion of the tumour referred to in the text; and in the middle the section of the osseous plate which was in the heart of the tumour.

III. Tumour of Case II.

IV. Microscopic elements of the tumour of Case II.; viz., oval and round nuclei in a homogeneous matrix; short fibres with nuclei, and others long and narrow; nucleated cells of different sizes; cells in a cluster, like a brood-cavity; a hard concretion, laminated bodies of various sizes, and with different objects within them, as described in the text; and, to one side of the figure, a number of the loose flattened bodies, some with double outlines, some with buds, some with small cavities. × 350.

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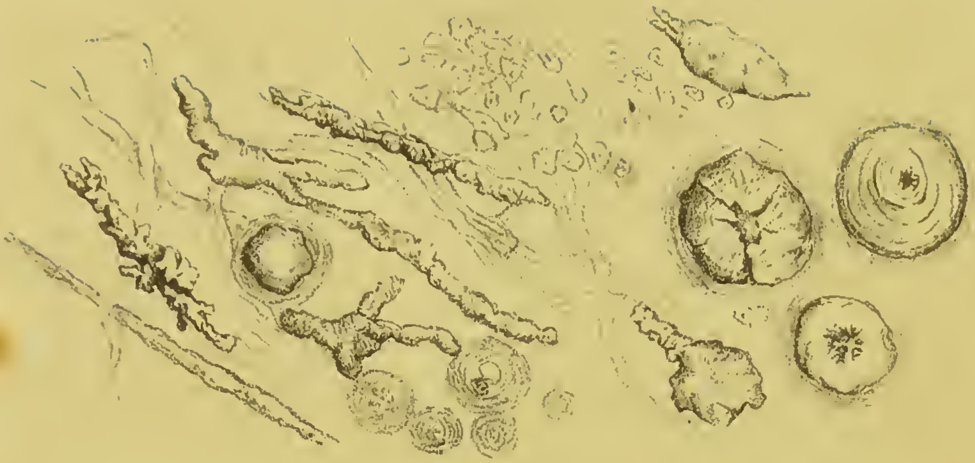

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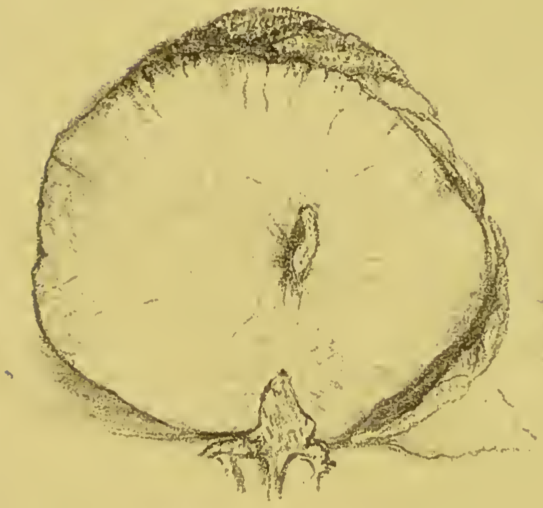

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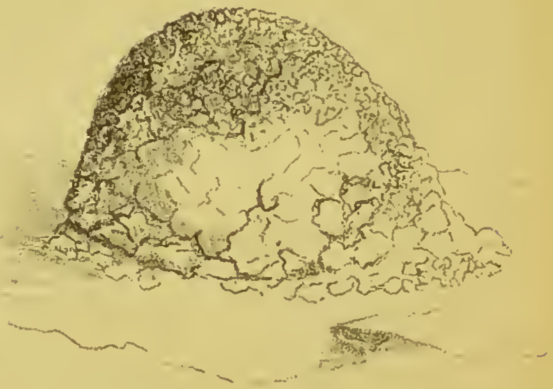

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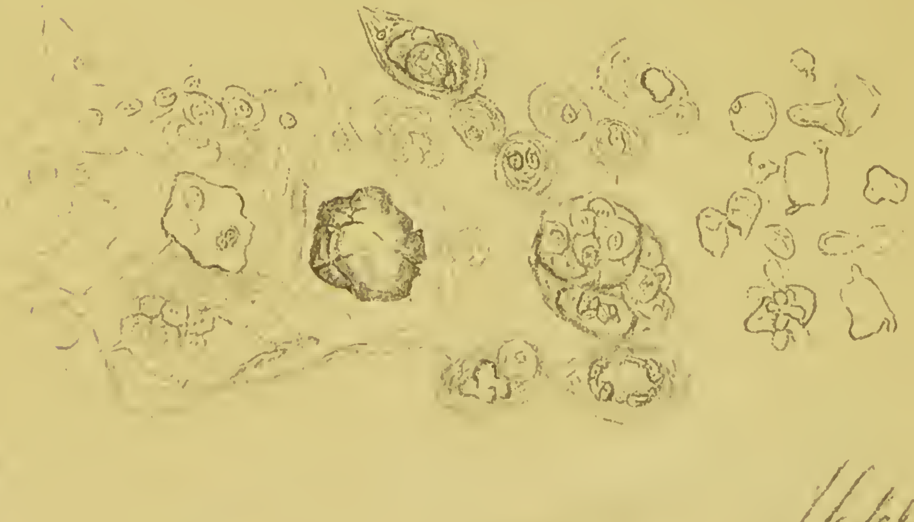

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